Fish Passage at Road Crossings Assessment – Part II Caribou-Targhee National Forest FY 2007

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EXECUTIVE SUMMARY

Inventory

The Fish Passage at Road Crossings Inventory for 2007 on the Caribou-Targhee National Forest evaluated 277 road/stream crossings and completed full culvert inventory assessments on 80 of those crossings on fish-bearing streams (Table 1). In addition the Caribou-Targhee National Forest survey crew completed 197 partial assessments to collect basic descriptive data on any crossing that did not warrant a full inventory (i.e. bridges, fords, and inaccessible culverts located on private lands). Information on crossing types that were partially assessed can be found in Table 8.

Table 1. Summary of Aquatic Organism Passage Barriers for 2007

Lifestage	RED	GREY	GREEN	Total
Adult	**50**	**16**	**14**	**80**
Juvenile	**60**	**15**	**5**	**80**

Red = is a barrier to fish. GREY = is unknown and requires further assessment to determine passability. Green = is passable to these life stages of fish. As seen in the table a large majority of stream crossings were found to be barriers to all life stages of fish.

The total number of road crossings across the Forest is estimated to be 1080. Half of the road crossings are located on fish bearing streams and were inventoried in 2005 and 2007 (Table 2). In 2005 the highest priority road crossings on streams considered Yellowstone and Bonneville cutthroat trout strongholds and water quality impaired were inventoried. Results from this survey are summarized in Table 2 and can be found with the 2005 Fish Passage at Road Crossings Assessment Report: (http://www.fs.fed.us/r4/caribou-targhee/fisheries/documents/index.shtml).

Table 2. Summary of 2005 Priority Crossings and 2007 Secondary Crossings Inventoried and those Estimated to be Remaining.

Priority (2005)	# Complete Assessments Inventoried	# Partial Assessments Inventoried	# Crossing Sites Remaining
BCT and YCT Stronghold Streams	**38**	**244**	**0**
303(d) Listed Streams	**35**		
BCT and YCT Strongholds on 303(d) listed streams	**13**		
Secondary (2007)			
All Other Fish Bearing Streams	**80**	**197**	**0**
All Non-fish Bearing Streams	**0**	**0**	**639**
Total	**166**	**441**	**639**

In 2007 all road crossings on remaining fish bearing streams were inventoried. These streams contain mixed populations of salmonids with non-native fish as the majority. In general, the 2007 culvert inventory provides us with a second tier of fish passage restoration opportunities.

Of the 80 complete assessments that were rated twice (for juvenile and adult passage requirements) 69% of these crossing sites do not meet the criteria to pass fish (RED), and are a barrier for at least one life stage (Table 1). Of the 80 crossings surveyed 63% were a barrier to adults and 75% were found to be a barrier to juveniles (Table 1). Most of the "RED" crossings were associated with circular and squashed pipe-arch culverts (Table 3). Culverts that were a barrier to adult salmonids are prioritized by available upstream habitat in Appendix A. Of the 80 complete assessments that were rated twice (for juvenile and adult passage requirements) only 12% of the culverts evaluated met the passage criteria and were not a barrier (GREEN) to at least one life stage. Of the 80 crossings surveyed 18% were not a barrier to adults and less than 6% were found not to be a barrier to juveniles (Table 1). Nine of the fourteen

crossings that ranked Green for adults were considered to be impassable for juveniles. These crossings included two circular culverts, and seven squashed pipe-arch culverts. The remaining 19% of the 80 complete assessments that were rated twice (for juvenile and adult passage requirements) were found to be undeterminable (GREY) and candidates for further evaluation (e.g.; Fish Xing software).

This report summarizes the prioritization of sites, the methods and assumptions, the evaluation criteria, the results, and a proposal for rehabilitation or reconstruction. All of the full assessments from 2007 are summarized by 5th field watersheds in Table 4. Prioritization of secondary restoration opportunities is also detailed by location in Appendix A.

Inventory Results

The majority of culverts (63% for adults and 75% for juveniles) in the eighteen 5th field watersheds surveyed in 2007 rated out in the "RED" category (Table 1). All of these barriers were found to be circular or squashed pipe-arch culverts (Table 3).

Recommendations

The 2007 Aquatic Organism Passage (AOP) survey effort took a look at fish bearing streams across the forest that have non-native fish assemblages. These road/stream crossings are important but are considered as second tier restoration priorities. Primarily, AOP enhancement efforts should be focused on reducing habitat fragmentation on streams containing native fish. These streams were surveyed in 2005 and represent the restoration priorities for the forest.

We have taken these results and focused on those crossings considered "RED" for one or both life stages. Priority was assigned mainly by calculating the miles of habitat available upstream from the crossing. All passage data displayed and utilized in this report were based upon field evaluations versus using the Fish Pass database results. This decision was made due to database inconsistencies with calculating bankfull to structure widths at dual culverts. Prioritization of crossings by site is presented in Table 4 and Appendix A.

Table 3: Crossing Type Designations by Lifestage and Passability

Crossing Type	Adult Red	Juvenile Red	Adult Grey	Juvenile Grey	Adult Green	Juvenile Green
Circular	30	36	8	4	4	2
Pipe-Arch	20	24	8	11	9	2
Open-Bottom-Arch	0	0	0	0	1	1
Total	**50**	**60**	**16**	**15**	**14**	**5**

This table represents a summary of the types of crossings (mainly culverts) that were encountered during the full crossing assessment. The majority of crossings inventoried were circular (53%) and pipe-arch (46%) culverts. Other types of crossings, like bridges and fords were identified as non priorities for full passage assessments.

The order within Table 4 is based upon the amount of perennial stream habitat upstream blocked for at least one salmonid lifestage. While Appendix A only prioritizes site that are known barriers to adult salmonid movement. Note that some perennial stream miles may not necessarily provide suitable fish habitat, but may provide habitat for other aquatic-dependent species. All culvert replacement projects should include interdisciplinary coordination. A Fisheries Biologist should be consulted prior to planning the removal of any upstream migration barrier. Professional Fisheries staff will need to evaluate existing fish distribution data or conduct new presence/absence monitoring to determine appropriate actions to be taken at barrier crossings. As a result of this consultation some culverts

deemed "RED" may require no passage restoration activities to benefit the fisheries resource. Crossings that contain dual culverts with mixed passage ratings should also be analyzed by a Fisheries Biologist to determine if restoration activities are warranted.

The survey methodology developed by San Dimas is very conservative. It must be, to account for the abilities of most migratory aquatic biota found in the National Forest System to migrate upstream. The participation of Caribou-Targhee National Forest Fisheries Biologists in the selection of culvert replacement projects from the priority list in this document will be important to account for this conservative analysis.

The cost of replacement is based on an average cost for replacing similar-sized culverts with open-bottom arches. Based on past and current replacements on other southern Idaho Forests, construction and supplies alone average approximately $60,000. Planning costs are added to the construction and supply cost to estimate the total cost. However, some culvert replacements will cost substantially more than this average. For example, the Trout Creek culvert replacement utilized a culvert pre-fit with weirs to account for channel instability while allowing upstream migration of fish. Other replacement scenarios may require a very wide replacement structure, such as a bridge, to span the bankfull width, resulting in costs 4-5 times higher than the average described above.

Caribou-Targhee National Forest personnel worked with contractors to replace Targhee Creek, Howard Creek, Garden Creek and Trout Creek culverts in 2005. The Burns Creek culvert was replaced in 2006. In 2007 culverts were replaced on Skinner Creek, Allan Canyon Creek, and Mink Creek. In 2008 culvert crossings on Horseshoe Creek, Deep Creek, and Wolverine Creek are scheduled for replacement.

The majority of stream crossings on fish bearing streams on the Caribou-Targhee National Forest lands have been identified and assessed during the 2005 and 2007 survey efforts. Both years reports and maps are located at the following link: (http://www.fs.fed.us/r4/caribou-targhee/fisheries/documents/index.shtml). At this time only crossings on small headwater tributaries or small non fish bearing streams remain to be analyzed on FS lands. We recommend continuing the AOP inventory across private lands, when needed, to determine AOP barriers below the FS boundary. Some of these crossing located on private lands have been inventoried but there is large amount that were not inventoried due to access constraints. These culverts will need to be handled on a case by case basis by a professional Fisheries Biologist.

Table 4. Secondary Sites for Culvert Replacement on the Caribou-Targhee National Forest

Forest-wide results based on 2003 San Dimas Aquatic Organism Passage Inventory Protocol

HUC 5	Stream	Crossing ID	Crossing Type	Juvenile Field Rating	Adult Field Rating	Miles Blocked Upstream	Perennial Miles Upstream
1704021404	Miners Creek	FS006 16.5	circular	red	red	16.58	16.58
1601020104	Georgetown Creek	FS225 0.01	circular	red	red	9.31	9.31
1602030919	Rock Creek	FS037 0.8	circular	red	grey	8.52	8.52
1704021406	Ching Creek	FS027 4.1	pipe arch	red	red	6.71	6.71
1704020208	Willow Creek	FS030 11.50	circular	grey	grey	6.57	8.75
1704020208	Willow Creek	FS030 11.51	circular	grey	grey	6.57	8.75
1704020307	North Boone Creek	FS261 13.90	pipe arch	red	red	6.14	6.14
1704020307	North Boone Creek	FS261 13.91	pipe arch	red	red	6.14	6.14
1704020402	South Moody Creek	FS218 6.2	circular	red	red	6.04	6.04
1704020208	Taylor Creek	FS035 0.9	pipe arch	red	grey	6.01	6.01
1704021406	West Camas Creek	FS006 9.80	pipe arch	red	grey	5.58	5.58
1704020208	Meyers Creek	FS045 0.62	circular	red	grey	5.33	5.33
1704020208	Meyers Creek	FS045 0.63	circular	red	red	5.33	5.33
1704021404	Middle Three Mile Creek	FS021 0.3	circular	red	red	5.29	5.29
1704020202	Snow Creek	FS092 3.5	circular	red	red	5.14	10.09
1704021404	Dairy Creek	FS006 0.6	circular	red	grey	4.99	11.04
1601020104	Georgetown Creek	0.5MileRD 0.1	pipe arch	red	red	4.60	13.92
1704020410	Mill Creek	FS009 0.7	circular	red	red	4.04	4.04
1704021406	West Camas Creek	FS011 0.11	circular	red	grey	4.01	10.50
1704021406	Pete Creek	FS010 0.9	circular	red	red	4.00	4.21
1704021406	Trail Creek	FS029 1.2	pipe arch	red	red	4.00	4.00
1704020209	Moose Creek	FS292 1.50	pipe arch	grey	green	3.92	3.92
1704020209	Moose Creek	FS292 1.51	pipe arch	grey	green	3.92	3.92
1704020202	North Fork Fish Creek	FS082 0.8	pipe arch	red	red	3.88	3.88
1704021404	Modoc Creek	FS005 2.3	pipe arch	red	grey	3.30	3.30
1704021404	Dairy Creek	FS087 0.1	pipe arch	grey	green	3.23	3.23
1704021406	Kay Creek	FS026 0.8	circular	red	red	2.96	2.96
1704020210	Canyon Creek	FS060 2.4	pipe arch	red	red	2.89	2.89
1704021404	Telephone Creek	FS017 0.7	circular	red	red	2.82	2.82
1704020208	Howard Creek	FS035 2.30	circular	red	red	2.66	2.66
1704020208	Howard Creek	FS035 2.31	circular	red	grey	2.66	2.66
1704020209	West Fork Hotel Creek	FS048 2.1	circular	red	red	2.25	2.25
1704021404	White Pine Creek	FS323 4.6	circular	red	red	2.23	2.23
1704020202	Schaefer Creek	FS470 0.5	pipe arch	grey	grey	2.22	2.22

1704020208	Willow Creek	FS046 3.0	circular	red	red	2.18	2.18
1704020210	Twin Creek	FS061Spur 0.1	pipe arch	red	red	2.17	3.41
1704020202	Snow Creek	FS094 1.6	circular	grey	green	2.03	4.95
1704021404	Three Mile Creek	FS477 0.4	circular	red	red	1.95	1.95
1704020202	Fish Creek	FS092 0.4	circular	red	red	1.87	2.97
1704020208	Trib of Dry Creek	FS327 4.0	circular	red	red	1.86	1.86
1704020312	Squirrel Creek	FS264 11.9	pipe arch	red	red	1.62	1.62
1704020202	Snow Creek	FS094 4.8	pipe arch	grey	green	1.60	1.60
1704021404	Kite Canyon Creek	FS323 4.4	circular	red	red	1.40	1.40
1704021406	Pete Creek	FS006 7.7	pipe arch	grey	grey	1.36	5.57
1704020208	Taylor Creek	FS030 16.3	circular	red	red	1.36	7.37
1704020202	Snow Creek	FS518 0.2	pipe arch	grey	green	1.31	2.91
1704020308	Calf Creek	FS261 19.1	circular	red	red	1.30	1.30
1704020802	South Fork Mink Creek	FS163 2.4	circular	grey	grey	1.29	1.29
1704010411	Anderson Gulch	FS009 2.4	circular	red	red	1.26	1.26
1704020210	Twin Creek	FS061Spur 4.3	circular	red	red	1.24	1.24
1704020210	Reas Creek	FS066 3.7	pipe arch	red	red	1.19	1.19
1704020202	Fish Creek	FS092 2.3	pipe arch	grey	grey	1.11	1.11
1704020209	Tyler Creek	FS052 4.10	pipe arch	red	red	1.06	1.06
1704020209	Tyler Creek	FS052 4.11	pipe arch	red	red	1.06	1.06
1704020409	Kiln Creek	FS088 0.8	pipe arch	red	red	1.04	1.04
1704020207	Icehouse Creek	FS030 11.4	pipe arch	red	red	1.03	1.03
1704021404	Sheep Creek	FS325 3.9	circular	red	green	0.94	0.94
1704021406	Trib of West Camas Creek	FS006 9.82	pipe arch	red	grey	0.92	0.92
1704020209	Coffee Pot Creek	FS052 2.8	circular	red	red	0.91	0.91
1704021406	Little Creek	FS027 2.2	circular	red	red	0.84	0.84
1601020104	Georgetown Creek	100West 0.01	pipe arch	red	red	0.83	14.75
1704020202	North Fork Fish Creek	FS092 0.1	circular	red	red	0.77	4.65
1704020207	East Fork Icehouse Creek	FS030 11.3	circular	red	red	0.73	0.73
1704021406	Scalp Creek	FS564 0.4	circular	red	red	0.59	0.59
1704020308	Calf Creek	FS261 18.0	pipe arch	grey	grey	0.48	1.77
1704021406	Little Creek	FS027 1.9	pipe arch	red	red	0.43	1.26
1704020308	Calf Creek	FS261 17.60	pipe arch	red	red	0.38	2.16
1704020308	Calf Creek	FS261 17.61	pipe arch	red	red	0.38	2.16
1704021404	Three Mile Creek	FS021 2.7	pipe arch	red	red	0.29	2.24
1704021404	Grouse Creek	FS004 0.8	circular	red	red	0.24	0.24
1704020204	Trib of Warm River	FS150 0.1	pipe arch	red	red	0.22	0.22
1704021406	Pete Creek	FS010 3.5	circular	red	red	0.21	0.21

1704020402	South Moody Creek	FS218 1.9	circular	red	red	0.11	6.15
1704021406	Bear Gulch Creek	FS019 1.5	open bottom arch	green	green	0.00	0.00
1704020209	Moose Creek	FS059 3.00	pipe arch	green	green	0.00	0.00
1704020209	Moose Creek	FS059 3.01	pipe arch	green	green	0.00	0.00
1602030919	Rock Creek	FS037 1.5	circular	green	green	0.00	0.00
1704021406	West Camas Creek	FS011 0.10	circular	green	green	0.00	0.00
1704020410	Mill Creek	FS009 2.70	pipe arch	grey	green	Not Determined	
1704020410	Mill Creek	FS009 2.71	pipe arch	grey	green	Not Determined	

Inventory Procedure Discussion

Initial Prioritization of Sites

Upon learning that the Caribou-Targhee National Forest would be funded for culvert assessment in 2007, the Forest Fisheries Personnel determined where to conduct survey efforts. In 2005 aquatic organism passage (AOP) surveys had already encompassed subbasins that contained native cutthroat trout and water quality impaired streams across the Caribou-Targhee National Forest. These streams represent the highest priority for stream crossing restoration efforts. It was decided that the 2007 AOP survey effort should be directed at inventorying all remaining crossings on fish bearing streams across the forest. In 2005 perennial streams were intersected with roads, using GIS spatial layers, to estimate the number of potential survey sites. It was estimated that a total of 1080 crossings were located on FS lands. In 2005 crews inventoried 330 sites leaving an estimated 750 crossings left to inventory in 2007.

Field Crews and Inventory Collaboration

The Caribou-Targhee National Forest utilized 2-3 person crews to conduct the field surveys during 2007. Crew production was tracked by fisheries biologists throughout the season to maintain crew production and data quality. With the high number of culverts to be inventoried, crew leads were given the responsibility for determining what sites warranted a full inventory. At sites that did not warrant a full inventory, tertiary information such as GPS locations, type of structure present, and field notes concerning the stream reach were collected to assemble partial assessments. The partial assessment provided the Forest with information on stream crossings that were not culverts, crossings that were not accessible (located on private land), and crossings located on non fish bearing reaches. This information will be used as an aid in future analysis documents to evaluate stream connectivity and interactions between the road and stream systems. A summary of partial and full crossing assessment counts is located in Tables 7 and 8.

Additional Methods & Assumptions
Evaluation Criteria

The USFS Region 1 fish passage evaluation criteria screening process was used to classify existing crossings as meeting, needing further hydraulic analysis, or failing to meet fish passage criteria for selected resident fish species. Region 1 constructed two flow charts (Figures 2 and 3), similar to ones developed by the California Department of Fish and Game (2001), for juvenile and adult cutthroat and bull trout. These flowcharts attempt to define whether passage is provided through existing structures at the time of survey.

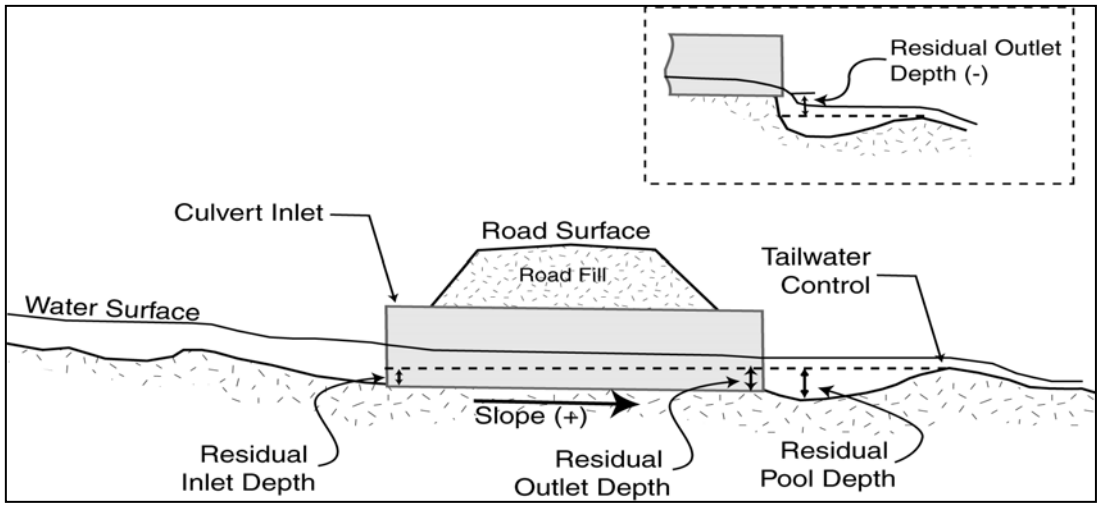
The regional passage evaluation criteria flowcharts first determine whether the crossing meets natural channel simulation criteria. It is important to remember that these evaluation criteria are not as rigorous as stream simulation DESIGN criteria. Criteria for evaluating natural channel simulation include:

- Streambed substrate is continuous in character and profile throughout the entire length of structure (Representative bed material must be arranged in a stable configuration that provides for flow diversity, energy dissipation, and continuity of bedload transport throughout the structure).

- Crossing is set at or below stream grade – no outlet perch (No perch is assumed if streambed substrate is continuous throughout the structure).
- Structure width is equal to or greater than the average bankfull width of the channel out of the influence of the crossing – no constriction of the active channel exists.
- No steep drops occur immediately upstream of structure – channel slope between the crossing inlet and the first upstream holding habitat is similar to overall channel gradient (This must be verified for all crossings initially considered passable from the screen).

If the site inventory data verifies the above natural channel simulation criteria, the crossing is considered adequate for passage of all salmonids, including the weakest swimming life stage. If not, one proceeds through the flowcharts to further evaluate each culvert until a passage status is determined. These criteria can be viewed in three stages:

1. getting into the culvert,
2. getting through the culvert,
3. and getting out of the culvert.



Residual Pool Depth = (Elev $_{\text{Tailwater Control}}$ – Elev $_{\text{Pool Bottom}}$)
Outlet Drop = (Elev $_{\text{Tailwater Control}}$ – Elev $_{\text{Outlet Invert}}$)
Residual Inlet Depth = (Elev $_{\text{Tailwater Control}}$ – Elev $_{\text{Culvert Inlet}}$)
Culvert Slope Percent = (Elev $_{\text{(Inlet Invert – Outlet Invert)}}$ / Dist $_{\text{(Inlet Invert – Outlet Invert)}}$ X 100)
Inlet Gradient = (Elev $_{\text{(Inlet Gradient Control Point – Inlet Invert)}}$ / Dist $_{\text{(Inlet Gradient control Point – Inlet Invert)}}$ X 100

Figure 1. Measurements used in evaluation criteria (from Taylor and Love, 2001).

Getting into the Culvert
Outlet Drop

Culvert outlets that are perched above the water surface are common obstacles to fish passage. Perch height is flow-dependent. Therefore, the stream discharge at the time of the field assessment does not provide for a comprehensive measurement of perch height. The Region 1 protocol uses a conservative assessment of perch height by comparing the outlet invert elevation to the tailwater control elevation (Figure 1). This is a flow-independent measurement. Ideally, the perch height should be evaluated at

various discharges up to the high-flow design discharge. However, this would be too time-consuming for this comprehensive assessment of all culverts in the region.

Based on literature review and consultation with fisheries biologists, which is also documented in this section, the following screening criteria were utilized to evaluate culvert outlets (Table 5).

Table 5. Culvert Outlet Screening Criteria.

	GREEN (juvenile)	GREEN (adult)	GREY (juvenile)	GREY (adult)	RED (juvenile)	RED (adult)
Culvert Outlet	Not perched plus culvert backwatered at least 0.5'	Perch ≤ 0.5' plus culvert backwatered at least 0.5'	Perch 0-0.34' plus outlet pool depth at least 1.25 times perch height	Perch 0-0.8' plus outlet pool depth at least 1.25 times perch height	Perch > 0.34'	Perch > 0.8'
			Note: Hydraulic analysis required to determine passability.			

Through biological monitoring, fish have been observed jumping considerable vertical and horizontal distances to clear obstacles. However, few studies have actually documented the jumping ability of fish, especially for young and small fish. Lab studies have determined that ideal jumping conditions for fish occur when the ratio of the jump height to the depth of the pool below the jump is 1:1.25 (Robison et al 1999). NMFS SW Region (2001) states that culvert perch needs to be evaluated for both high design flow and low design flow and should not exceed 1 foot for adult fish and 6 inches for juveniles with a jump pool of at least 2 feet. Burton (1998) states in his protocol for assessing fish passage at culverts on the Boise River Basin that the standard maximum jumpable height for adult trout is 0.984 foot (11.8 inches) and 1.968 foot (23.6 inches) for adult salmon. The Idaho Dept of Lands (1998) guidelines for new stream crossing installation permits a maximum drop of 1 foot from the culvert outlet when a holding pool is provided. The USFS R6 and R10 fish passage assessment screening criteria indicate that culverts with an outlet perch height of less than four inches may accommodate upstream movement of juvenile coho salmon, but the crossing is only considered passable (GREEN) when the structure is not perched.

Getting through the Culvert

Culvert Slope

Water velocity within a culvert is determined primarily by culvert length, width, gradient and roughness. If the culvert gradient is too steep, or the culvert width is narrower than the streambed width, the water velocity will be increased within the culvert. Even very slight changes in the slope of the culvert (0.5% to 1.0%, for example) or substrate roughness within the structure may significantly change the culvert velocity.

The Caribou-Targhee National Forest utilized the following screening criteria, developed by the Boise National Forest Fisheries Biologist to evaluate culvert slope (Table 6). This criterion is based on literature review and consultation with fisheries biologists, which is also documented in this section.

Table 6. Culvert Slope Screening Criteria.

	GREEN (juvenile)	GREEN (adult)	GREY (juvenile)	GREY (adult)	RED (juvenile)	RED (adult)
Embedded Culvert	Maximum Gradient ≤1% (unless inlet depth > 0.34') plus Culvert width/ Bankfull width ratio ≥ 0.7 plus No outlet drop	Maximum Gradient ≤2% (unless inlet depth > 0.34') plus Culvert width/ Bankfull width ratio ≥ 0.7 plus Perch ≤ 0.5'	Maximum Gradient ≤1% plus Perch < 0.34' plus Insufficient Backwatering	Maximum Gradient ≤2% plus Perch 0.5-0.8' plus Insufficient Backwatering	Gradient >1%	Gradient >2%
Note: In cases where the residual inlet depth meets the minimum depth criteria, backwatering exists, and there is no outlet perch (or up to 0.5 foot perch for adults), then culvert gradient is automatically allowed to be higher to some degree.			Note: Hydraulic analysis required to determine passability.			

According to Idaho Dept. of Lands (1998), bare culverts greater than 50 ft long will cause fish-passage problems for adult spring-migrating trout (6-12 inches) if installed at over a 0.5% gradient and for juvenile and weak-swimming fish if over 0%, unless properly backwatered. If adequately backwatered, the culvert could be up to 4% gradient for adults and 3% for juveniles and still allow upstream passage. The Idaho guidelines state that culverts without streambed substrate that are less than 50 ft long can be installed up to 1% gradient for adult passage and 0.5% for juvenile passage. NMFS SW Region (2001) new installation guidelines require the slope of a non-embedded culvert to be less than 0.5% for salmon and steelhead. In the USFS Region 6 and 10 passage assessment matrices for juvenile Coho salmon, culvert grade for bare culverts must be less than 0.5% to be considered passable (GREEN). Bare culvert crossings with gradients between 0.5% and 1% would be considered GREY for juvenile passage and would require hydraulic analysis to determine passability. Pipe arches with less than 100% substrate coverage can have a gradient of up to 2% (GREY) before being considered non-passable (RED). If the culvert contained 100% substrate coverage of adequate depth (20% of culvert rise), then culvert gradient could be up to 2% in circular culverts with 2x6 corrugations and still be passable (GREEN) and go as high as 4% in that same situation before being considered non-passable (RED). The California Dept of Fish and Game (2001) assessment flowchart determines that culverts with slopes greater than 2% and not adequately backwatered and/or with a perch are considered non-passable (RED) for adult and juvenile anadromous salmonids. Culverts with less than 2% gradient and not adequately backwatered and/or with a perch are considered GREY, thus requiring hydraulic analysis.

Residual Inlet Depth

Residual inlet depth is the depth of water at the inlet of the structure under no flow (or very low flow) conditions. When the outlet tailwater control elevation is higher than that of the inlet invert, the residual inlet depth will be a positive number and the structure will be backwatered at all flows (Figure 1). This positive depth, i.e. backwatering, is generally conducive to passage of most species and life stages since it tends to reduce velocities within the structure. It is important to note that spring-fed streams may never experience very low flows and therefore maintain ample water depth throughout the structure even without a positive residual inlet depth. The main reasons for setting a minimum residual

inlet depth are to ensure that depth is adequate to allow passage at low flow conditions, and to acknowledge that backwatering may facilitate passage through culverts that are otherwise too steep.

The minimum depth necessary for successful passage depends on fish size, as larger fish require more water for passage. Based on a review of research findings and stream crossing design guidelines, the minimum water depths that allow most adult and juvenile trout to pass through a culvert, range from 0.25 foot (3 inches) to 1 foot (12 inches). For adult steelhead and salmon, the minimum water depth required for passage varies from 0.59 foot to 1 foot. Belford and Gould (1989) found that 0.26 foot (3.12 inches) was a sufficient depth to pass adult trout through the six Montana highway culverts evaluated in their study. The Idaho Department of Lands fish passage manual (1998) sets minimum depth criteria of 0.25 foot (3 inches) during migration. California Department of Fish and Game (1998) has a minimum of 1 foot for adult Chinook and steelhead and 0.5 ft for juvenile salmon and all trout. The Washington Department of Fish and Wildlife (2000) has a design standard minimum depth criterion of 0.8 foot for adult trout and 1 foot for adult Chinook and steelhead. Thompson (1972) found that for successful upstream migration of adult salmon and trout through non-embedded culverts, a minimum water depth of 0.59 foot (7.1 inches) for steelhead and 0.79 foot (9.5 inches) for Chinook is required. The NMFS SW Region (2001) requires a minimum water depth of 1 foot (12 inches) for adult steelhead and salmon and 0.5 foot (6 inches) for juvenile salmon when designing non-embedded culverts. Burton (1998) suggested having a minimum water depth of 0.49 foot (5.9 inches) for adult trout, and 0.984 foot (11.8 inches) for adult salmon on the Boise National Forest. Trout in Virginia were observed maneuvering a minimum depth of flow of 0.29 foot (3.5 inches) (Warren and Pardew 1998).

Getting out of the Culvert
Average Bankfull Width to Inlet Width Ratio

Constriction is addressed at two levels within the flowchart. The first discriminator is found within the natural channel simulation criteria – the culvert width must be equal to or greater than the average bankfull width and have substrate retained throughout the structure. If the crossing meets these criteria, it is not constricting the channel and considered GREEN. Secondly, in all other structures (embedded or non-embedded), the culvert width must be at least equal to 70% (ratio of 0.7) of the bankfull channel width as well as meeting requirements for outlet drop and slope to be categorized as GREEN. If the culvert width is less than 50% (ratio of 0.5) of the average bankfull channel width, it is considered RED for all life stages. In most cases, if a culvert overly constricts the channel, the tailwater control becomes scoured and incised by the higher velocity, backwatering is significantly reduced or eliminated and a perch may or may not form. In other words, if the structure overly constricts the channel, most likely there is an outlet perch as well. Constriction thresholds are based on initial culvert inventory data review and hydraulic analysis for a number of sites in USDA Forest Service Region 1.

Note that for all natural channel simulation crossings and other structures categorized as GREEN, it will still be necessary to review the inlet gradient and identify sites that have a steep drop in the channel profile directly in front of the culvert inlet providing evidence that the crossing does indeed constrict the channel (Evidenced by hourglass shapes that suggest velocities within the structure are higher than that of the stream channel). This steep slope can be a migration barrier to both adult and juvenile fish, because it creates supercritical flow just inside the inlet. Therefore, if the inlet gradient is excessive compared to channel gradient upstream of the crossing, the site will be designated as GREY until hydraulic analysis can be completed for the site.

Evaluation Categories

The following categories will be used to classify crossings for juvenile and adult cutthroat and Bull trout for Region 1:

CHANNEL SIMULATION: Conditions assumed to be passable for all species/life stages.

GREEN: Conditions assumed adequate for passage of the analysis species life stage.

GREY: Conditions may not be adequate for the analysis species life stage presumed present. Additional analysis is required to determine the extent of barrier. It is here where we would denote possible flow barriers using hydraulic analysis.

RED: Conditions do not meet passage criteria at all desired flows for the analysis species life stage; assumed to be a barrier for that life stage.

It is important to note that fish may be able to pass through a number of the culverts identified in the RED and GREY categories during portions of the year, i.e. the culvert may actually be only a partial (flow) barrier. However, passage may only be possible during a very discrete period. The primary concern is that passage may not be possible for a particular life stage during the more extreme flow periods and most important migration times of the year such as during spring runoff and low base flows.

The passage evaluation criteria flowcharts do not cover all possible scenarios, thus the inventory data need to be thoroughly reviewed for any unique passage problems that may exist at crossings initially categorized as CHANNEL SIMULATION or GREEN. For example, a crossing may meet all flowchart criteria for passage but may still have an inlet drop, significant debris or sediment blockage, or a break within the structure itself. Further manual data review will identify and redefine these crossings appropriately.

Juvenile salmonid fish passage evaluation criteria at flows less than bankfull flows (developed by Region 1)

(NOT INTENDED TO BE USED FOR DESIGNING NEW STRUCTURES)

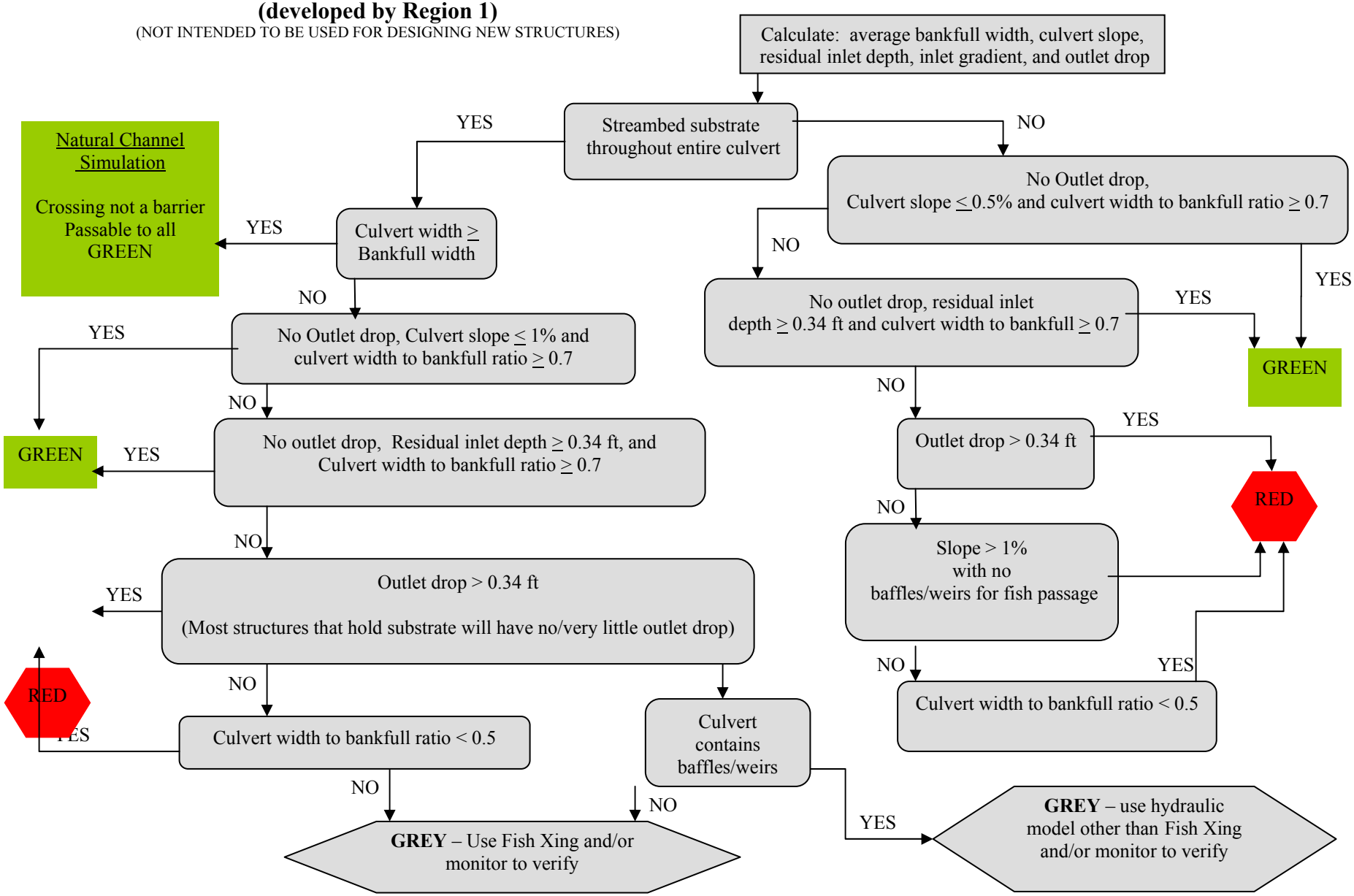


Figure 2. Fish passage evaluation criteria for juvenile salmonids (developed by USDA Forest Service Region 1).

Adult salmonid fish passage evaluation criteria developed by Region 1

(NOT INTENDED TO BE USED IN DESIGNING NEW STRUCTURES)

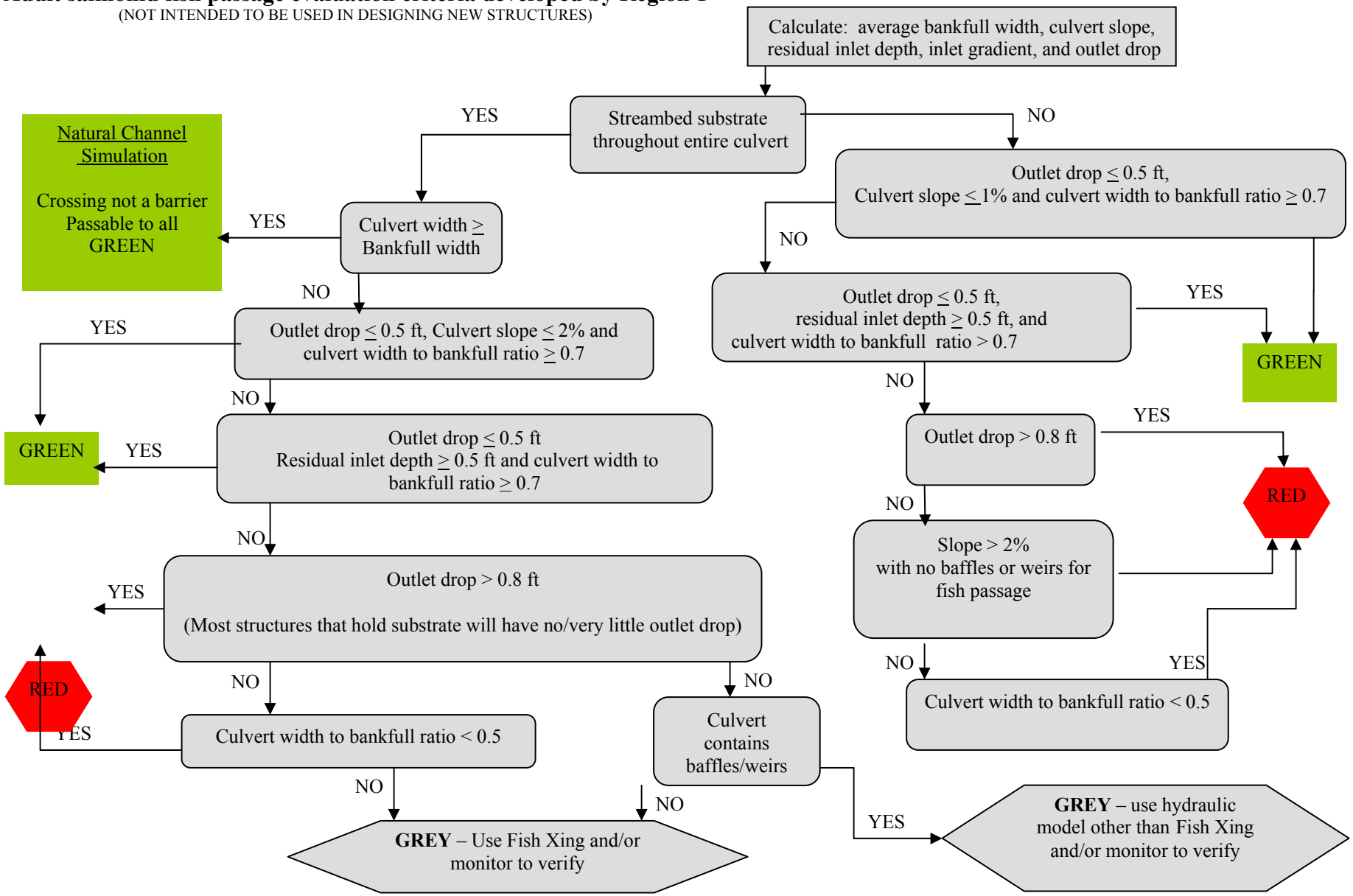


Figure 3. Fish passage evaluation criteria for adult salmonids (developed by USDA Forest Service Region 1).

Assumptions for Determining Miles of Blocked Habitat

The location of each culvert was used to determine how many miles were blocked or accessible. If the culvert was a barrier, the distance up to the next impassable culvert, a natural barrier, or end of fishes' distribution was considered blocked to fish below the culvert. Fish surveys and extent of perennial stream designations were used to approximate miles blocked. These distances were then summarized per resident juvenile and adult to represent total miles of stream blocked by life stage. Miles accessible within those subwatersheds surveyed were also totaled.

It was assumed that if a fish occurred above a culvert identified as a barrier, it was either a resident life history fish belonging to a populations isolated by the culvert, or an adult or offspring fluvial/adfluvial fish that, at certain flow conditions, could migrate through it.

In situations where a fish distribution occurred up to or slightly downstream of a culvert and not upstream, it was assumed that the culvert was a complete barrier to both juveniles and adults. It was also assumed that the species downstream had the potential to colonize habitat above the culvert to where a natural fish barrier occurred if the culvert was treated.

Table 7. Total Crossing Inventory Summary

Assessment Type	Count
Full Crossing Assessments	80
Partial Crossing Assessments	197
Inaccessible/ Bogus Sites	0
Total	**277**

Full Crossing = those crossings that were inventoried using entire protocol. Partial Crossing = those crossings that were inventoried just to make note of characteristics, but not considered a barrier. Inaccessible/ Bogus Sites = those crossings that did not actually exist in the field or were not accessible due to the road being overgrown or closed permanently.

Table 8. Summary of Partial Assessments and the Crossing Types Encountered

Crossing Type	Crossing Count
Circular Culvert	131
Bridge	51
Ford	2
Pipe Arch	10
Diversion Structure	1
Box Culvert	1
Open Bottom Arch	1
Total	**197**

This table represents a summary of the types of crossings that were encountered by field crews and given partial crossing assessments. While important data was collected, these sites were not given further consideration for fish passage issues.

Results

The majority of culverts (63% for adults and 75% for juveniles) in the eighteen 5th field subbasins surveyed rated out in the RED category (Table 1). Most of these pipes are circular or squashed pipe-arches, which occur in headwater tributaries (Table 3). These inventories were completed across the forest with the majority located within the Ashton and Island Park and Dubois Ranger Districts where non-native fish are abundant. Each culvert was evaluated by calculating the parameters necessary to move through the flowcharts (Figures 2 & 3). Three triggers including outlet drop (perch), channel constriction (culvert to bankfull width ratios), and culvert slope were analyzed to characterize fish passage at each location. At most locations with barrier (RED) culverts a combination of these triggers were encountered. At culvert outlets, scour and scour pools associated with perched pipes are a symptom caused by accelerated water velocities. These accelerated water velocities are usually attributed to localized conditions of increased slope and stream channel constriction.

Survey results determined that of the 80 complete assessments that were rated twice (for juvenile and adult passage requirements), 69% of these crossing sites do not meet the criteria to pass fish (RED) (Table 1). Across the forest these crossings block approximately 168 miles of habitat for juvenile and 134 miles of habitat for adult salmonids. Quantities of open (GREEN) stream miles associated with these crossings is estimated at 29 miles for juvenile and 46 miles for adult salmonids. Lastly, quantities of potentially blocked (GREY) stream miles are estimated at 36 miles for juvenile and 53 miles for adult salmonids. Restoration opportunities for each of these crossings that are a barrier (RED) for at least one lifestage of salmonid are discussed below.

Proposal for Rehabilitation and Reconstruction

Recommendations

The 2007 Aquatic Organism Passage (AOP) survey effort took a look at fish bearing streams across the forest that have non-native fish assemblages. These road/stream crossings are important but are considered as second tier restoration priorities. Primarily, AOP enhancement efforts should be focused on reducing habitat fragmentation on streams containing native fish. Yellowstone and Bonneville cutthroat stronghold streams were surveyed in 2005 and represent the AOP restoration priorities for the forest.

We have taken the results of this survey and focused on those crossings considered RED for at least one lifestage of salmonid. Priority was assigned mainly by calculating the miles of habitat available upstream from the crossing. Some perennial stream miles may not necessarily provide suitable fisheries habitat, but may provide habitat for other aquatic-dependent species. Prioritization of culverts is listed in Table 4 and is detailed below by individual site.

Culvert replacement projects should be conducted in an interdisciplinary fashion to account for biological, social, and physical characteristics of that particular crossing. For example, some crossings that pose a barrier to upstream-migrating fish may be desirable to protect native fish upstream from non-native fish downstream of the crossing. In addition, the San Dimas Methodology used for this assessment was very conservative to account for the migratory abilities of all aquatic biota in the Forest Service System. A barrier identified through this methodology may not be an entire barrier to species our particular Forest is conserving.

The majority of stream crossings on fish bearing streams on the Caribou-Targhee National Forest lands have been identified and assessed during the 2005 and 2007 survey efforts. At this time only crossings on small headwater tributaries or small non fish bearing streams remain to be analyzed on FS lands. We recommend continuing the AOP inventory across private lands, when needed, to determine AOP barriers below the FS boundary. Some of these crossing located on private lands have been inventoried but there is large amount that were not inventoried due to access constraints. These culverts will need to be handled on a case by case basis by a professional Fisheries Biologist.

Appendix A
Secondary Restoration Opportunities

1. The first priority site is FS006-16.5 on Miners Creek in the Beaver-Camas 4th field subbasin on the Dubois Ranger District. This culvert is the only culvert crossing located on Miners Creek on the Forest and blocks the most headwater habitat for culverts that ranked as being impassable. Results from the survey determined that this culvert is a barrier (RED) to both juvenile and adult salmonids. This culvert is known to block approximately 16.58 miles of stream habitat.

2. The second priority site is FS225-0.01 on Georgetown Creek in the Bear Lake subbasin on the Montpelier Ranger District. This culvert is located on BLM land just below the Right Fork of Georgetown Creek. This culvert is a barrier (RED) to all lifestages of salmonids and blocks approximately 9.31 miles of potential headwater habitat.

3. The third priority site is FS027-4.1 on Ching Creek in the Beaver-Camas 4th field subbasin on the Dubois Ranger District. This culvert is a barrier (RED) to all lifestages of salmonids and blocks approximately 6.71 miles of potential headwater habitat.

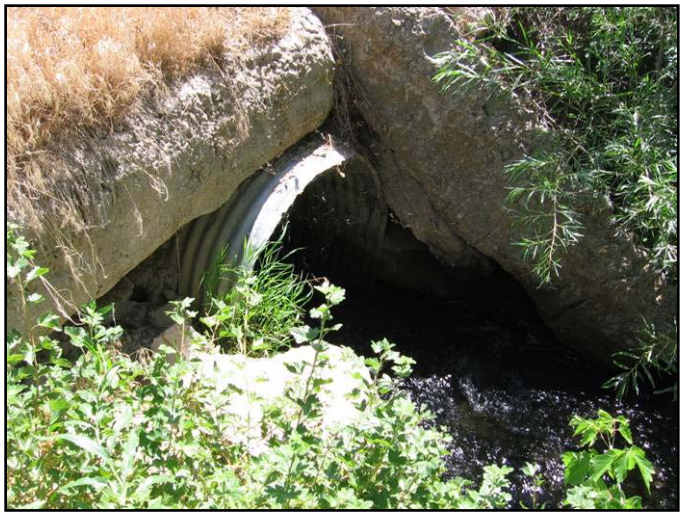
4. The fourth priority site is FS261-13.90 and 13.91 on North Boone Creek in the Lower Henrys 4th field subbasin of the Ashton-Island Park Ranger District. These culverts are a barrier (RED) to both lifestages of salmonids and blocks approximately 6.14 miles of potential headwater habitat.

5. The fifth priority site is FS218-6.2 on South Moody Creek in the Teton Basin 5th field watershed of the Teton subbasin on the Teton Ranger District. This culvert is a passage barrier (RED) to both lifestages of salmonids and blocks approximately 6.04 miles of headwater habitat.

6. The sixth priority site is FS045-0.62 and 0.63 on Meyers Creek in the Upper Henrys 4th field subbasin on the Ashton-Island Park Ranger District. One of the structures was determined to be a barrier (RED) to both life stages of salmonids while the other structure was determined to be a barrier (RED) to juveniles and a potential barrier (GREY) for adult salmonids. This culverts blocks approximately 5.33 miles of headwater habitat.

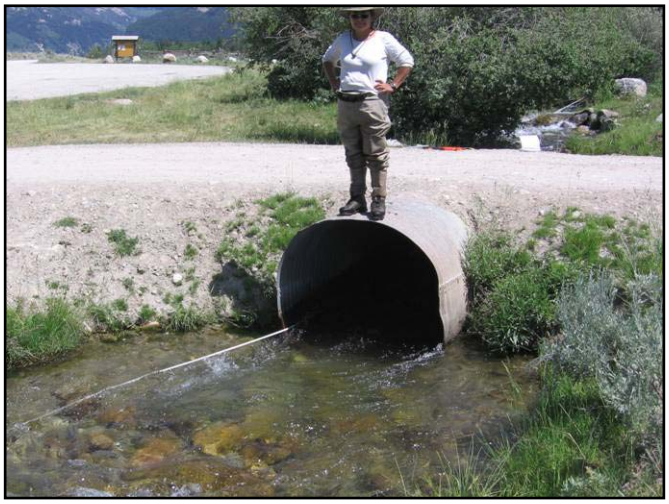
7. The seventh priority site is FS021-0.3 on Middle Three Mile Creek in the Beaver-Camas 4th field subbasin of the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 5.29 miles of headwater habitat.

8. The eighth priority site is FS092-3.5 on Snow Creek in the Henrys Fork Island Park Reservoir 5th field watershed of the Upper Henrys subbasin on the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 5.14 miles of upstream habitat for juveniles and an estimated 10.09 miles of habitat for adult salmonids. Two culverts exist above this site that were both rated as passable (GREEN) for adults and potential barriers (GREY) for juvenile salmonids.



9. The ninth priority site is 0.5MileRD-0.1 on Georgetown Creek in the Bear Lake subbasin on the Montpelier Ranger District. This culvert is located on ½ mile road on private land. This culvert is a barrier (RED) to all lifestages of salmonids and blocks approximately 4.60 miles of potential headwater habitat. This culvert in conjunction with other culverts blocks a total of 13.92 miles of upstream headwater habitat.

10. The tenth priority site is FS009-0.7 on Mill Creek in the Teton 4th field subbasin on the Teton Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids. This culvert blocks approximately 4.04 miles of headwater habitat.



11. The 11th priority site is FS010-0.9 on Pete Creek in the Beaver-Camas 4th field subbasin on the Dubois Ranger District. The crossing was determined to be a barrier (RED) to both lifestages of salmonids. This culvert blocks approximately 4.00 miles of headwater habitat. This culvert in conjunction with other culverts blocks a total of 4.21 miles of upstream headwater habitat.

12. The 12th priority site is FS029-1.2 on Trail Creek in the Beaver-Camas 4th field subbasin on the Dubois Ranger District. The crossing was determined to be a barrier (RED) to both lifestages of salmonids. This culvert blocks approximately 4.00 miles of headwater habitat.

13. The 13th priority site is FS082-0.8 on North Fork Fish Creek in the Henrys Fork Island Park Reservoir 5th field watershed of the Upper Henrys subbasin on the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 3.88 miles of headwater habitat.

14. The 14th priority site is FS026-0.8 on Kay Creek in the Beaver-Camas 4th field subbasin of the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids. This culvert blocks an estimated 2.96 miles of headwater habitat.

15. The 15th priority site is FS060-2.4 on Canyon Creek in the Upper Henrys 4th field subbasin on the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 2.89 miles of headwater habitat.

16. The 16th priority site is FS017-0.7 on Telephone Creek in the Beaver-Camas 4th field subbasin on the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids. This culvert blocks approximately 2.82 miles of headwater habitat.

17. The 17th priority site is FS035-2.30 and 2.31 on Howard Creek in the 4th field Upper Henrys subbasin of the Ashton-Island Park Ranger District. One of these culverts was a barrier (RED) to both lifestages and the other crossing was determined to be a barrier (RED) to juveniles and a potential barrier (GREY) for adult salmonids. This culvert blocks approximately 2.66 miles of headwater habitat.

18. The 18th priority site is FS048-2.1 on the West Fork Hotel Creek in the 4th field Upper Henrys subbasin of the Ashton-Island Park Ranger District. This culvert is a barrier (RED) to both lifestages of salmonids and blocks approximately 2.25 miles of headwater habitat.

19. The 19th priority site is FS323-4.6 on White Pine Creek in the Beaver-Camas 4th field subbasin on the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids. This culvert blocks approximately 2.23 miles of headwater habitat.

20. The 20th priority site is FS046-3.0 on Willow Creek in the 4th field Upper Henrys subbasin of the Ashton- Island Park Ranger District. This culvert is a barrier (RED) to both lifestages of salmonids. This culvert blocks approximately 2.18 miles of headwater habitat.

21. The 21st priority site is FS061Spur-20.1 on Twin Creek in the Upper Henrys 4th field subbasin on the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 2.17 miles of headwater habitat. This culvert in conjunction with another upstream culvert blocks an estimated 3.41 miles of headwater habitat.

22. The 22nd priority site is FS477-0.4 on Three Mile Creek in the Beaver-Camas 4th field subbasin of the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.95 miles of headwater habitat.

23. The 23rd priority site is FS092-0.4 on Fish Creek in the Henrys Fork Island Park Reservoir 5th field watershed of the Upper Henrys subbasin on the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.87 miles of headwater habitat. This culvert in conjunction with other upstream crossings blocks an estimated 2.97 miles of headwaters habitat.

24. The 24th priority site is FS327-4.0 on a tributary of Dry Creek in the 4th field Upper Henrys subbasin of the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.86 miles of headwater habitat.

25. The 25th priority site is FS264-11.9 on Squirrel Creek in the 4th field Lower Henrys subbasin of the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.62 miles of headwater habitat.

26. The 26th priority site is FS323-4.4 on Kite Canyon Creek in the Beaver-Camas 4th field subbasin of the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.40 miles of headwater habitat.

27. The 27th priority site is FS030-16.3 on Taylor Creek in the 4th field Upper Henrys subbasin of the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.36 miles of headwater habitat. This culvert in conjunction with other culverts blocks an estimated 7.37 miles of upstream habitat.

28. The 28th priority site is FS261-19.1 on Calf Creek in the 4th field Lower Henrys subbasin of the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.30 miles of headwater habitat.

29. The 29th priority site is FS009-2.4 on Anderson Gulch in the Palisades 4th field subbasin of the Palisades Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.26 miles of headwater habitat.

30. The 30th priority site is FS061Spur-4.3 on Twin Creek in the Upper Henrys 4th field subbasin on the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.24 miles of headwater habitat.

31. The 31st priority site is FS066-3.7 on Reas Creek in the Upper Henrys 4th field subbasin on the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.19 miles of headwater habitat.

32. The 32nd priority site is FS052-4.10 and 4.11 on Tyler Creek in the Upper Henrys 4th field subbasin on the Ashton-Island Park Ranger District. These culverts were both determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.06 miles of headwater habitat.

33. The 33rd priority site is FS088-0.8 on Kiln Creek in the Teton 4th field subbasin on the Teton Ranger District. This culvert was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.04 miles of headwater habitat. No photos were taken at this location.

34. The 34th priority site is FS030-11.4 on Icehouse Creek in the Upper Henrys 4th field subbasin on the Ashton-Island Park Ranger District. These culverts were both determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 1.03 miles of headwater habitat.

35. The 35th priority site is FS052-2.8 on Coffee Pot Creek in the Upper Henrys 4th field subbasin on the Ashton-Island Park Ranger District. This culvert was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 0.91 miles of headwater habitat.

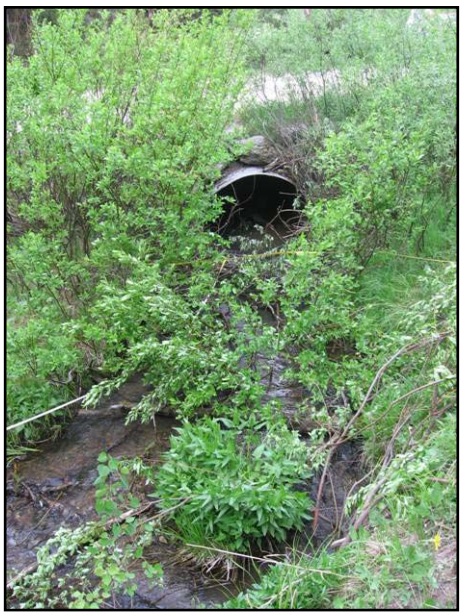
36. The 36th priority site is FS027-2.2 on Little Creek in the Beaver-Camas 4th field subbasin of the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids. This culvert blocks an estimated 0.84 miles of headwater habitat.

37. The 37th priority site is 100West-0.01 on Georgetown Creek in the Bear Lake subbasin on the Montpelier Ranger District. This culvert is located one block below the highway. This culvert is a barrier (RED) to all lifestages of salmonids and blocks approximately 0.83 miles of stream habitat. This culvert in conjunction with other crossings located upstream blocks an estimated 14.75 miles of headwater habitat.

38. The 38th priority site is FS092-0.1 on North Fork Fish Creek in the Henrys Fork Island Park Reservoir 5th field watershed of the Upper Henrys subbasin on the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 0.77 miles of stream habitat. This culvert in conjunction with other crossings located upstream blocks an estimated 4.65 miles of headwater habitat on North Fork Fish Creek.

39. The 39th priority site is FS030-11.3 on East Icehouse Creek in the Upper Henrys 4th field subbasin on the Ashton-Island Park Ranger District. This culvert was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 0.73 miles of headwater habitat.

40. The 40th priority site is FS564-0.4 on Scalp Creek in the Beaver-Camas 4th field subbasin of the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids. This culvert blocks an estimated 0.59 miles of headwater habitat.



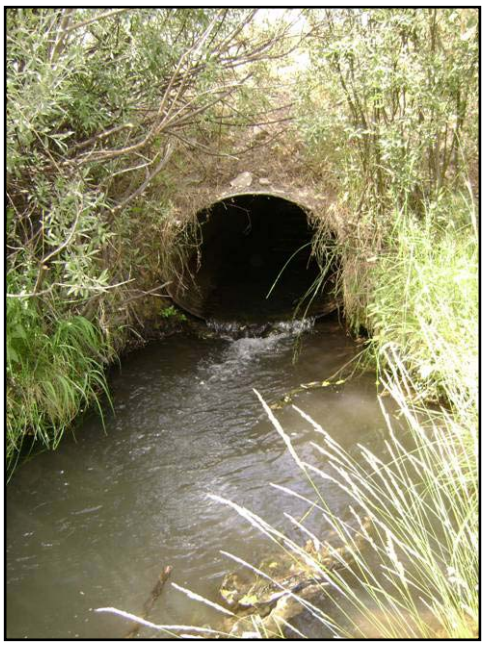
41. The 41st priority site is FS027-1.9 on Little Creek in the Beaver-Camas 4th field subbasin of the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids. This culvert blocks an estimated 0.43 miles of stream habitat. This culvert in conjunction with other culverts blocks a total of 1.26 miles of upstream headwater habitat.

42. The 42nd priority site is FS261-17.60 and 17.61 on Calf Creek in the 4th field Lower Henrys subbasin of the Ashton-Island Park Ranger District. Both of these structures were determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 0.38 miles of stream habitat. These culverts in conjunction with other culverts block a total of 2.16 miles of upstream headwater habitat.

43. The 43rd priority site is FS021-2.7 on Three Mile Creek in the Beaver-Camas 4th field subbasin of the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 0.29 miles of headwater habitat. This culvert in conjunction with other culverts blocks a total of 2.24 miles of upstream headwater habitat.

44. The 44th priority site is FS004-0.8 on Grouse Creek in the Beaver-Camas 4th field subbasin of the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 0.24 miles of headwater habitat. No pictures were taken at this location.

45. The 45th priority site is FS150-0.1 on a tributary of the Warm River in the Henrys Fork Island Park Reservoir 5th field watershed of the Upper Henrys subbasin on the Ashton-Island Park Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 0.22 miles of headwater habitat.



46. The 46th priority site is FS010-3.5 on Pete Creek in the Beaver-Camas 4th field subbasin of the Dubois Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 0.21 miles of headwater habitat.

47. The 47th priority site is FS218-1.9 on South Moody Creek in the Teton 4th field subbasin of the Teton Ranger District. This structure was determined to be a barrier (RED) to both lifestages of salmonids and blocks an estimated 0.11 miles of an available stream habitat. This culvert in conjunction with other culverts blocks a total of 6.15 miles of upstream headwater habitat.

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